

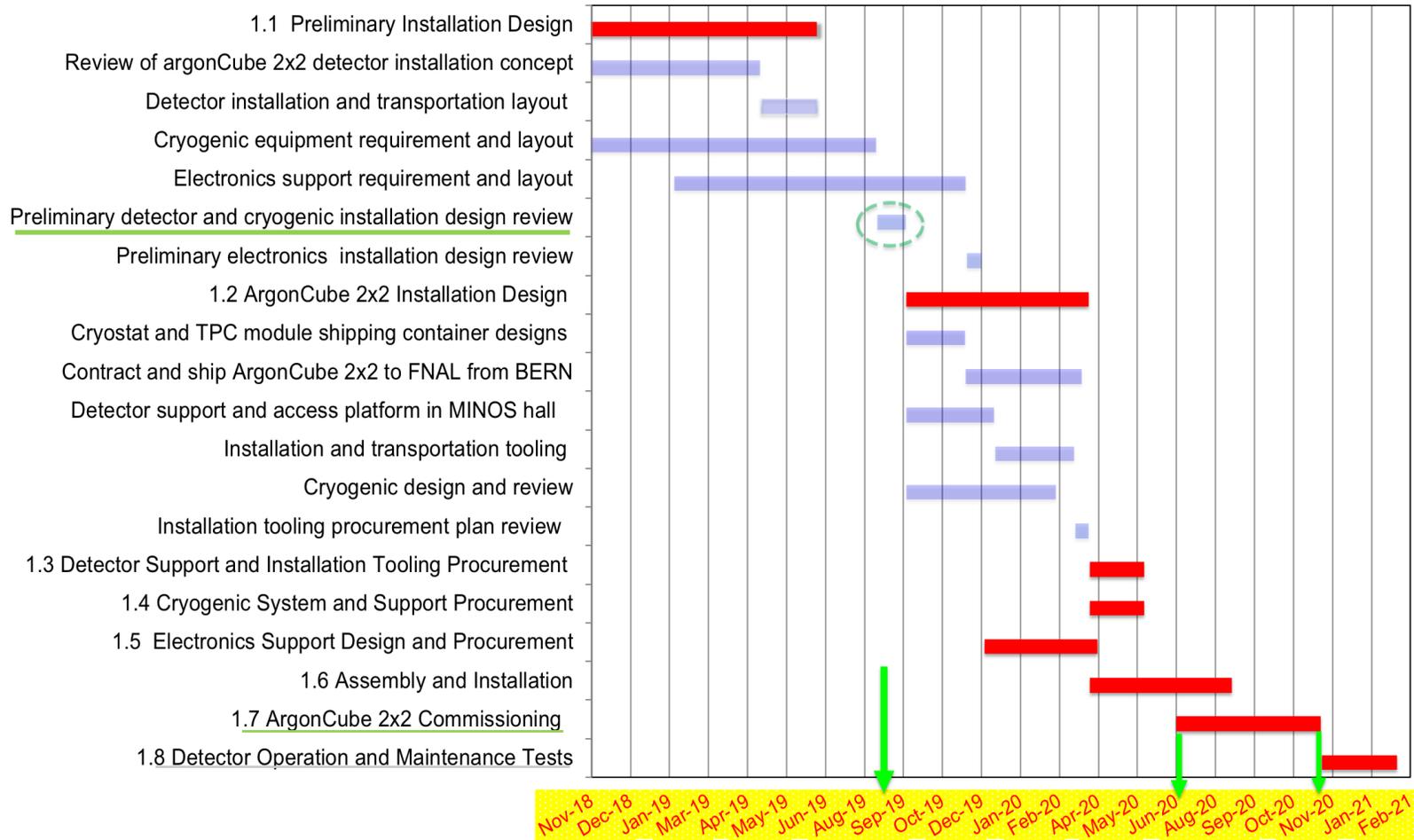
Scope of Works for 2x2 Test in MINOS

- Underground detector hall preparation
 - Minerva/Minos decommissioning and reconfiguration
 - 2x2 detector layout with support infrastructures
- Cooling and cryogenic infrastructures
 - LAr supply, cooling facility, purification and recirculation, control and monitoring
 - 2x2 cryostat vessel certification for use onsite at Fermilab
 - Cryostat venting, ODH mitigation and monitoring
- System integrations and safety design reviews
 - Interface of detector and cryo system
 - System integration of detector control and cryogenic control
 - System integration of readout and DAQ
 - Safety engineering design review (SEDR) for HV system
 - SEDR for front-end electronics
- Installation and commissioning

WBS Element	WBS Description	Lead Institutions	Start Date	Finish Date	FNAL Labor (type : working days)	M&S (\$)
1	ArgonCube 2x2 Installation in MINOS Hall		10/25/18	2/4/21		
1.1	Preliminary Installation Design		10/25/18	6/20/19		
1.1.1	Review of argonCube 2x2 detector installation concept	BERN	10/25/18	4/23/19	Eng.Phys:70d + CryoE:125d + ME.FEA:10d	
1.1.2	Detector installation and transportation layout	FNAL	4/24/19	6/21/19	Eng.Phys:10d + Mech.Design:30d+ME:10d	
1.1.3	Cryogenic equipment requirement and layout	FNAL/BERN	10/25/18	8/20/19	CryoE:180d+ME.FEA:20d+ME:45d+ Mech.Design:70d+Eng.Phys:50d	
1.1.4	Electronics support requirement and layout	FNAL/BERN/LBNL/UTA	1/25/19	11/20/19	EE:95d+ComSP:40d +CryoE:10d+Mech.Design:5d	
1.1.5	<i>Preliminary detector and cryogenic installation design review</i>	FNAL/BERN	8/21/19	9/19/19	CryoE:5d+ME:5d+Mech.Design:5d+ EE:5d+ Eng.Phys:5d	
1.1.6	Preliminary electronics installation design review	FNAL/BERN/LBNL/UTA	11/21/19	12/6/19	EE:5d+Mech.Design:5d +CompSP:5d	
1.2	ArgonCube 2x2 Installation Design		9/20/19	3/25/20		
1.2.1	Cryostat and TPC module shipping container designs	BERN/FNAL	9/20/19	11/19/19	ME:5d+Mech.Design:5d+Eng.Phys.5d	
1.2.2	<i>Contract and ship ArgonCube 2x2 to FNAL from BERN</i>	BERN	11/20/19	3/18/20		
1.2.3	Detector support and access platform in MINOS hall		9/20/19	12/19/19	ME:30d+Mech.Design.30d+ CryoE:5d+Eng.Phys:10d	
1.2.4	Installation and transportation tooling		12/20/19	3/10/20	ME:25d+Mech.Design:50d + Eng.Phys:10d	
1.2.5	Cryogenic design and review		9/20/19	2/20/20	cryoE: 150d+ Mech.Design:65d +Eng.Phys:50d	
1.2.6	Review of installation tooling procurement plans	BERN/FNAL	3/11/20	3/25/20	Eng.Phys.5d	
1.3	Detector Support and Installation Tooling Procurement	FNAL	3/26/20	5/21/20	ME:5d+ Eng.Phys:5d	\$20 K
1.4	Cryogenic System and Support Procurement	FNAL	3/26/20	5/21/20	Eng.Phys:10d	\$300 K
1.5	Electronics Support Design and Procurement		12/9/19	4/3/20	EE:100d+CompSP:100d +ME.Process:40d	\$70 K
1.6	Assembly and Installation		3/26/20	8/19/20	ME:30d+CryoE:55d+EE:45d+MT:160d+ ET:40d+CompSP:20d+Eng.Phys:50d+ ME.Process:10d	\$110 K
1.7	ArgonCube 2x2 Commissioning		6/23/20	11/18/20	ME.Process:25d+CompSP:55d+CryoE:40d +ME:15d+EE:35d+Eng.Phys.60	\$20 K
1.8	Detector Operation and Maintenance Tests		11/19/20	2/4/21	ME.Process:5d+CompSP:30d+CryoE:20d+ ME:10d+EE:10d+MT:30d+Eng.Phys.20d	\$20 K

	Cryo Engineer + Eng. Physicist	Mech Engineer + Designer	Electrical Engineer	Mech Techs + Elec Techs	Computing Specialist
Technical support for WBS 1.1 to 1.2 Designs (2019+)	475d + 205d	255d+265d	105d		45d
Technical support for WBS 1.3 to 1.8 Installation & commissioning & test (2020)	185d + 175d	75d	190d	190d + 40d	205d

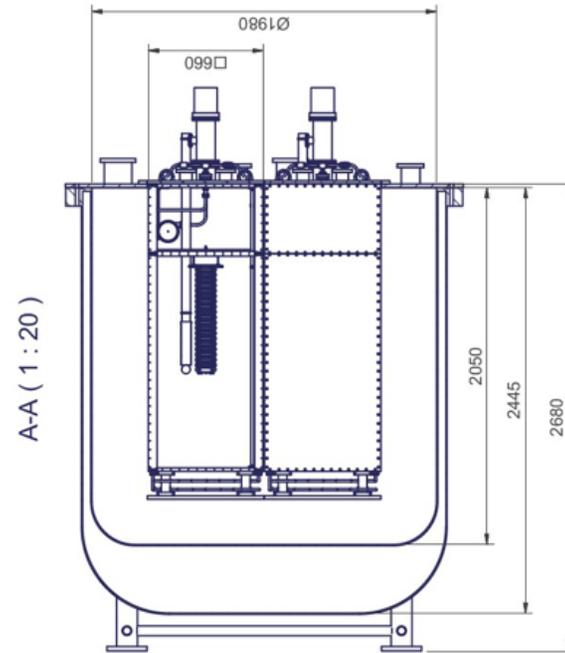
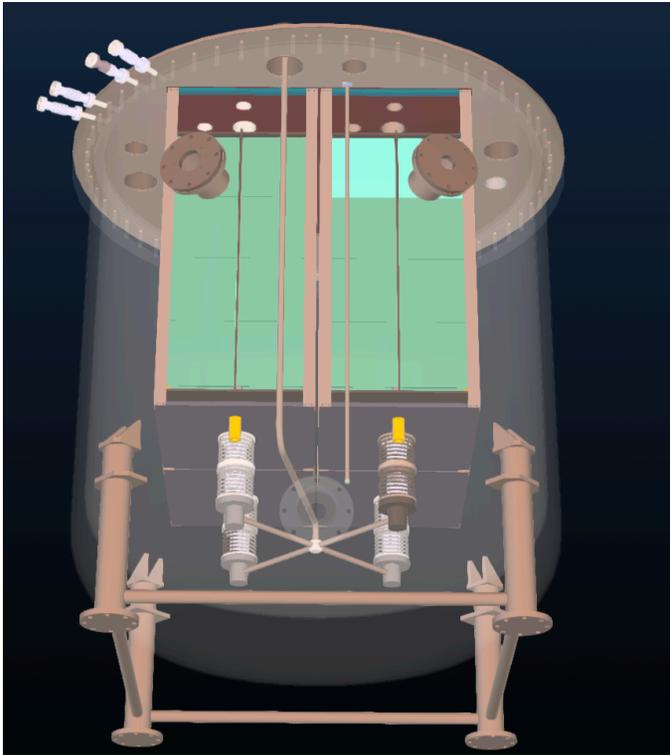
ArgonCube2x2@MINOS Schedule



Team for 2x2 Test in MINOS

- ArgonCube2x2 in MINOS is a Fermilab test experiment T-1563
- Project manager Ting Miao
 - Working with collaboration and neutrino division to complete management team
- Management team
 - Detector Hall Preparation and Underground Liaison: **Jim Kilmer** + **Steve Hahn** (FNAL)
 - Cryo Engineering and System Integration: **Min Jeong Kim** (FNAL)
 - Electrical Project Engineer for System Integration: **Linda Bagby** (FNAL)
 - Installation Support and Coordination: **Sai Kancharla** (FNAL) + **James Sinclair** (Bern)
 - TPC Installation and Integration: **Knut Skarpaas** (SLAC) + **James Sinclair** (Bern)
 - Detector and Cryogenic Controls: Collaboration + **Trevor Nichols** (FNAL)
 - Readout Electronics Integration & Trigger: **Dan Dwyer** (LBNL) + **Clarence Wret** (Rochester)
 - Online and DAQ: **Rochester** + **LBNL** + **FNAL** + Collaboration
 - Commissioning Coordination: **Igor Kreslo** (Bern)

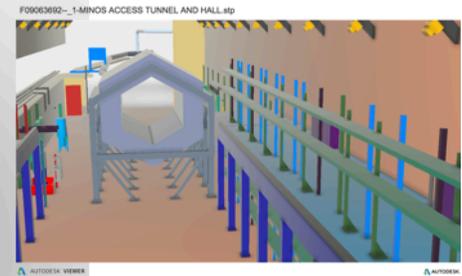
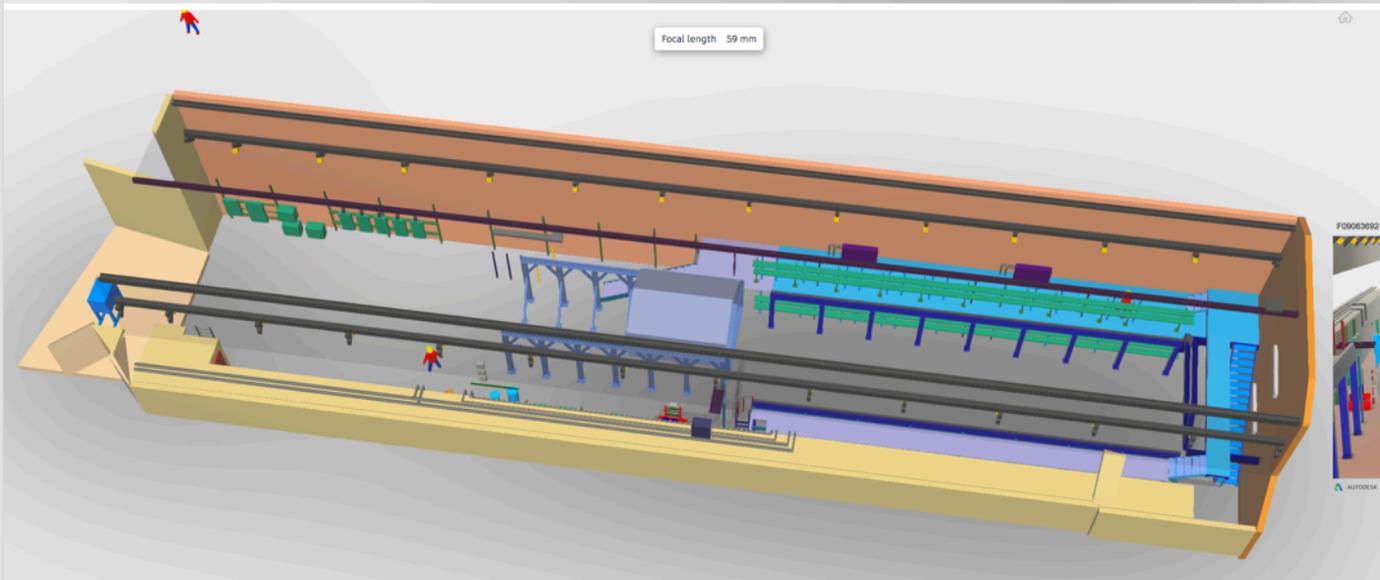
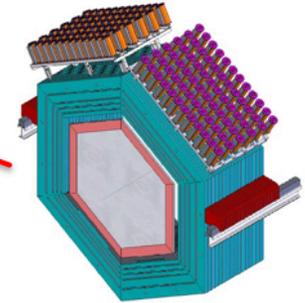
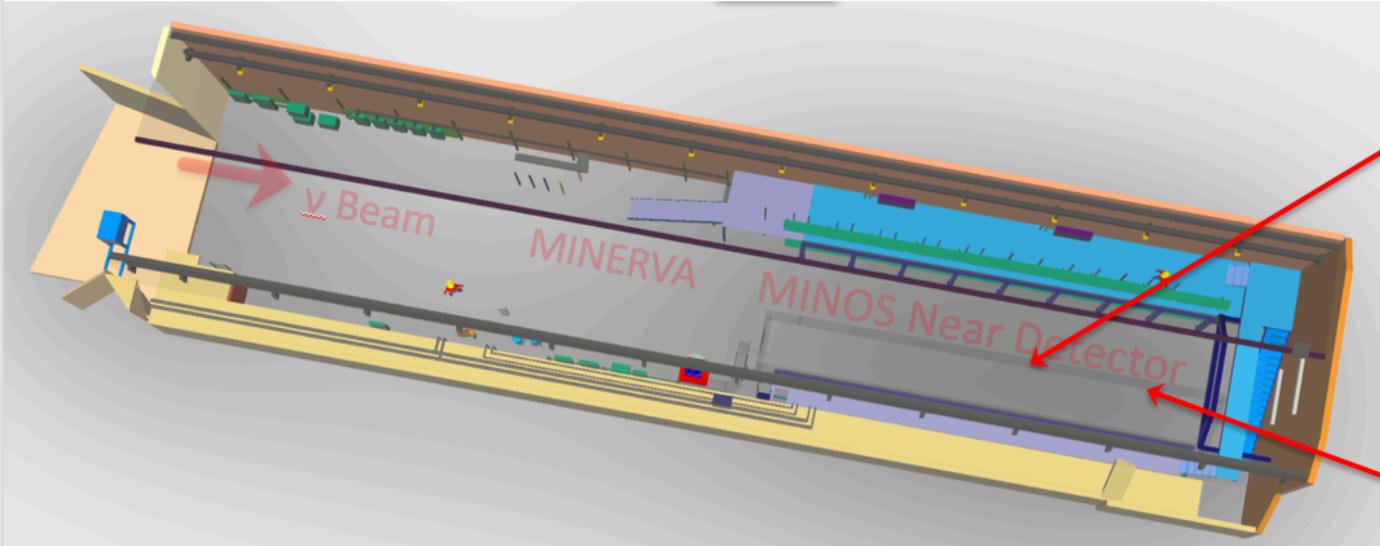




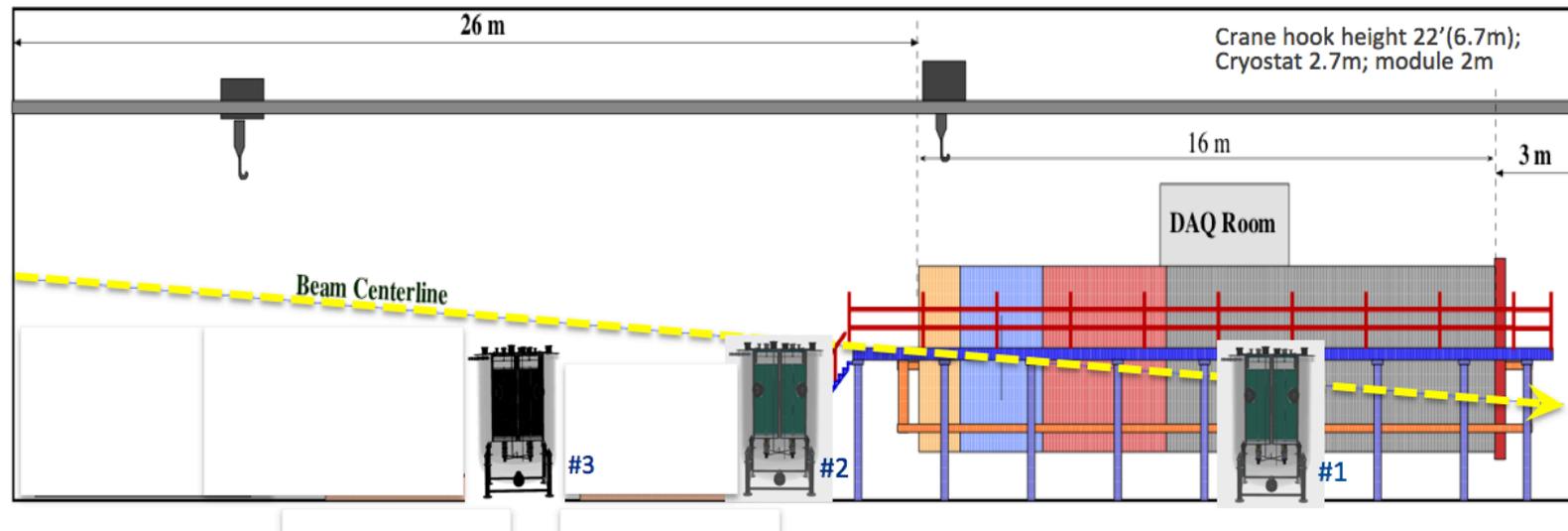
Cryostat 3d and TPC module in TeamCenter by Min Jeong: F10110625

Minos hall 3d model files in TeamCenter by Don Friend

Detector Location



Detector Location and Configuration

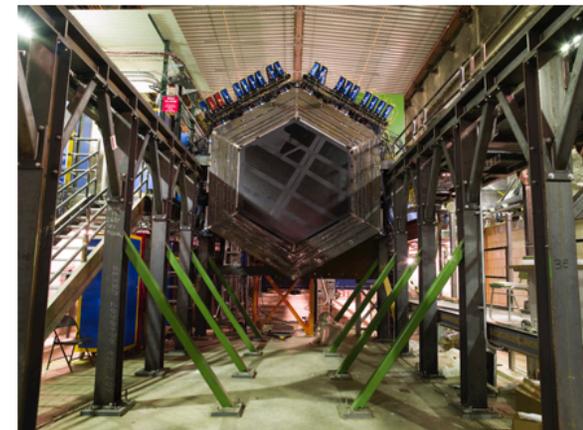


Best-wish detector configuration:

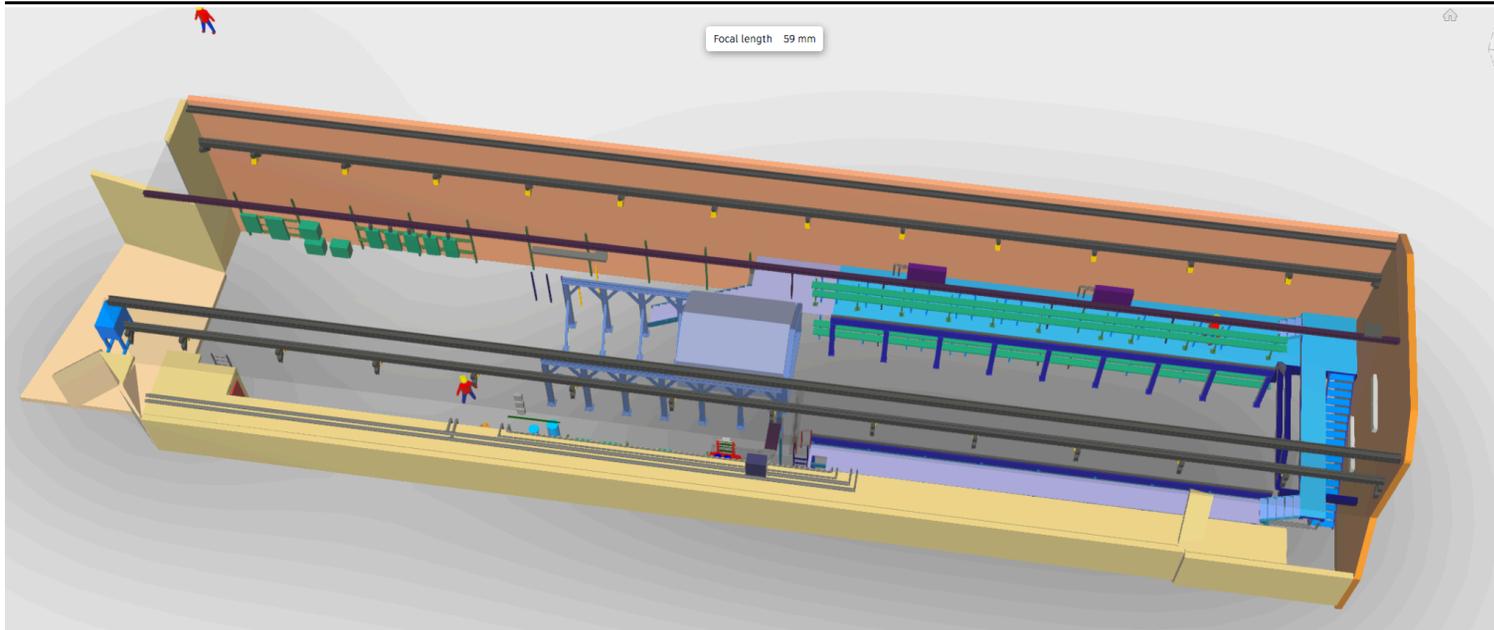
ArgonCube2x2 at position #1 (baseline)
+ Reconfigured Minerva modules (optional)

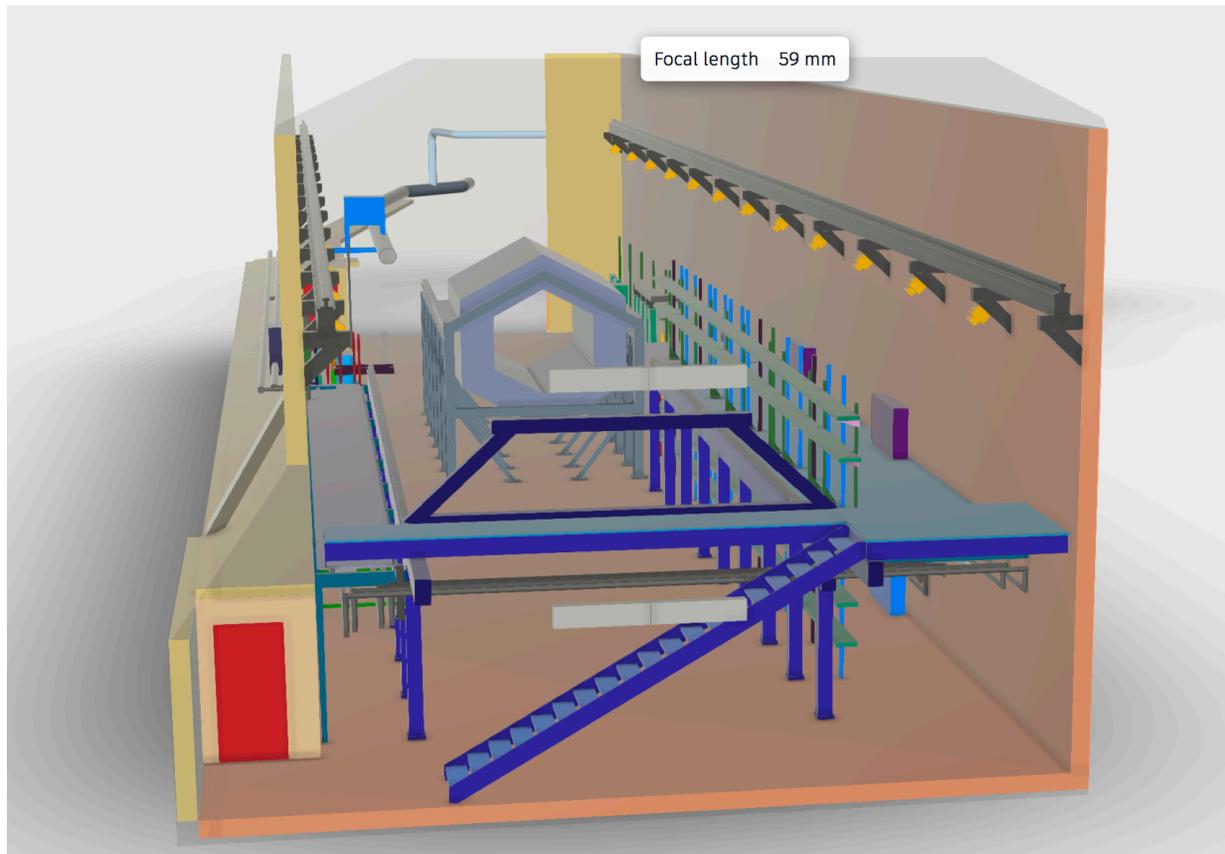
12 Minerva modules at upstream and 24 downstream

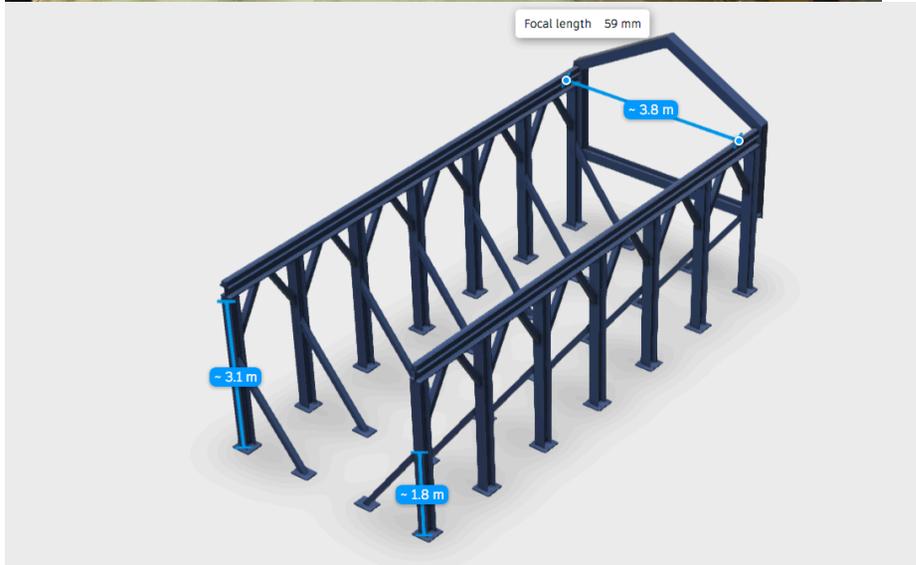
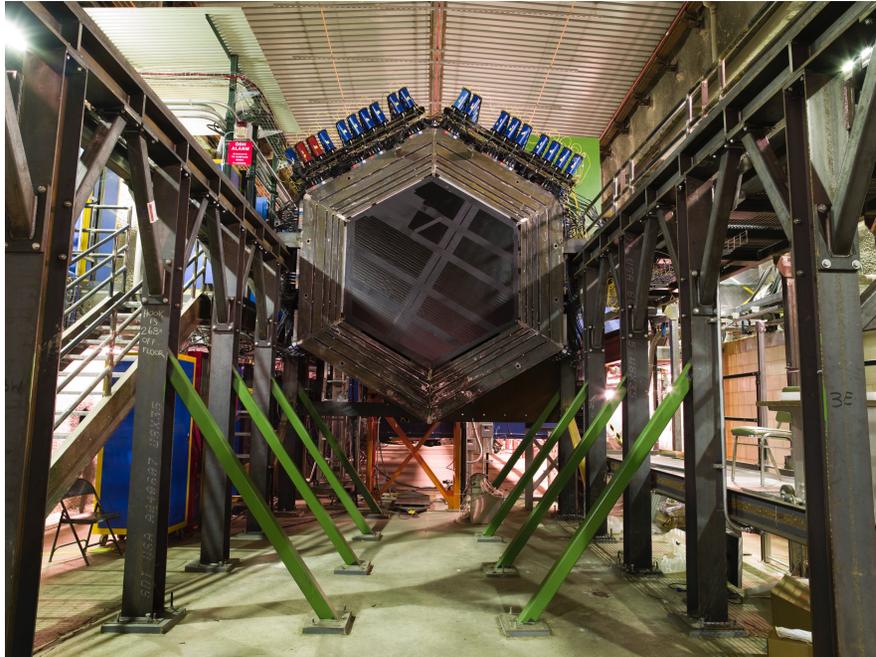
- Need to lower Minerva modules to match 2x2 height
- Add a new bookend to hold upstream modules
- Minerva/MINOS decommissioning plan is being finalized

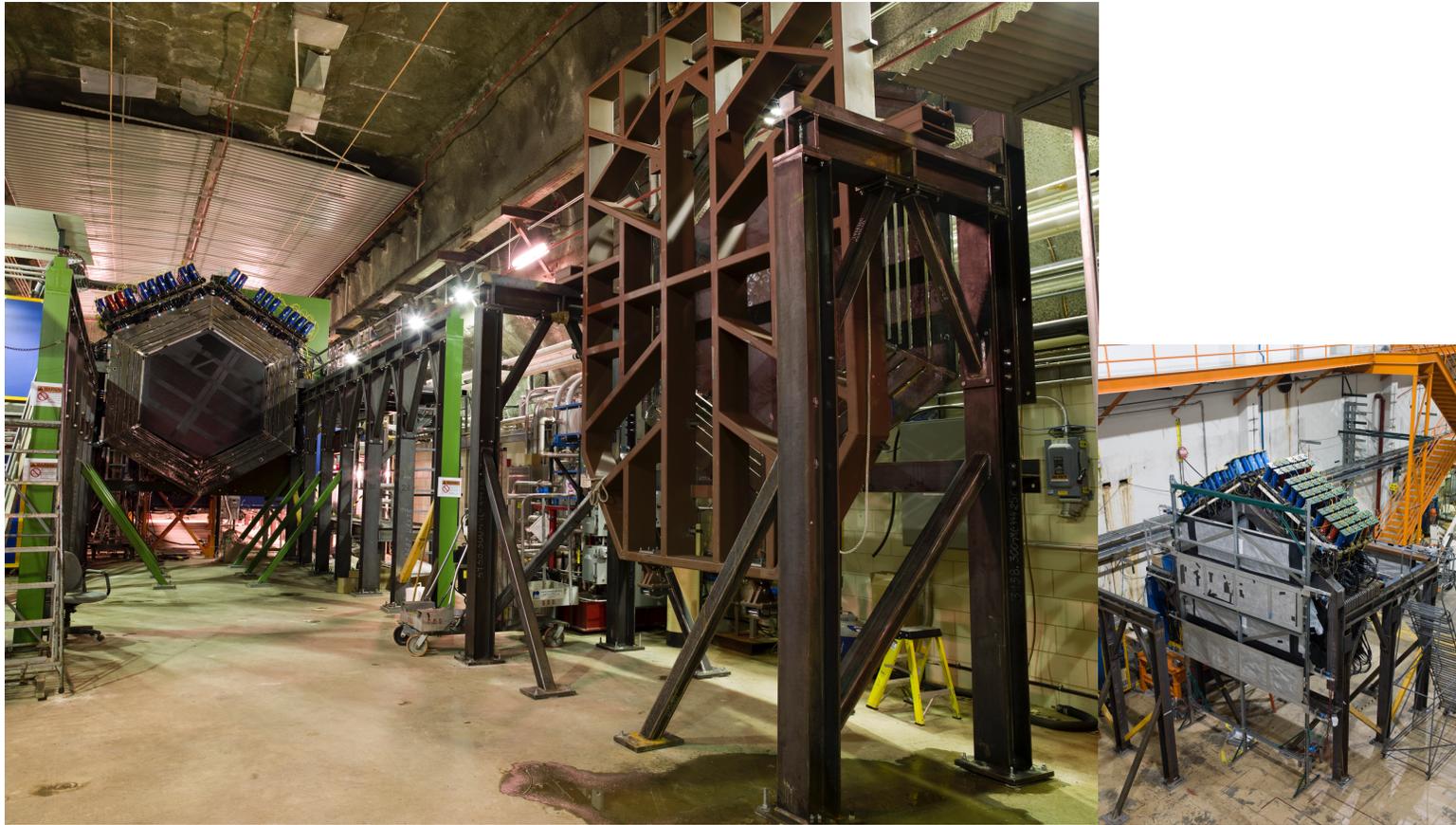


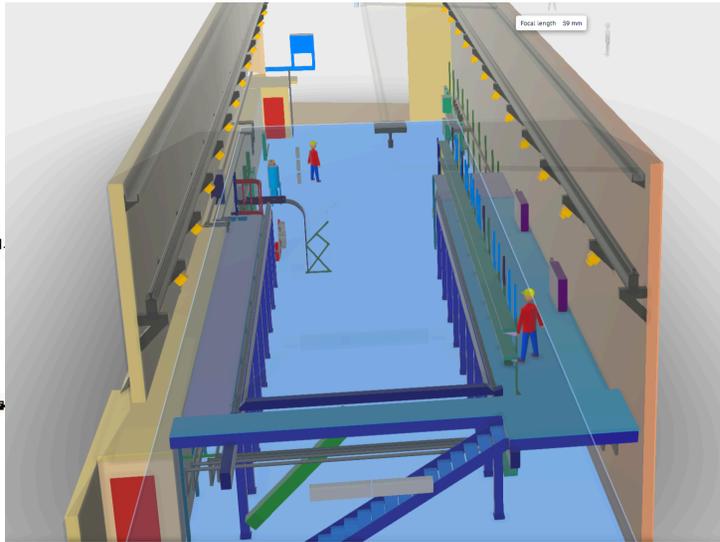
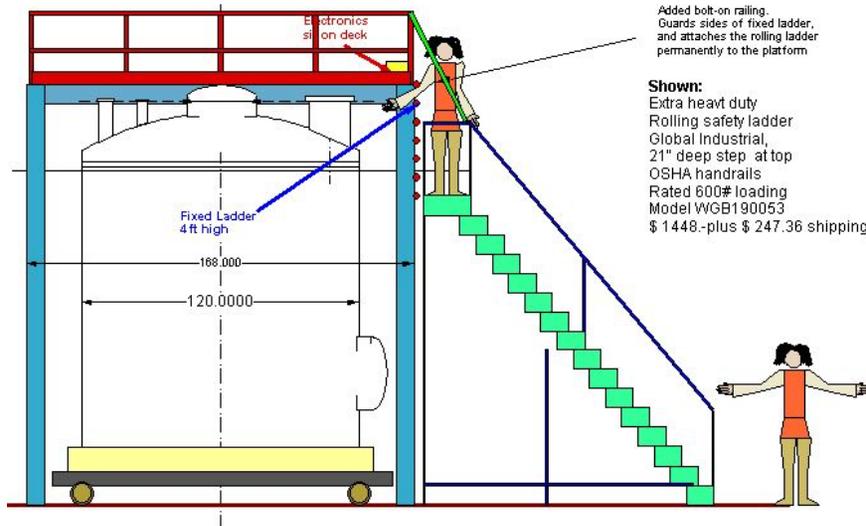




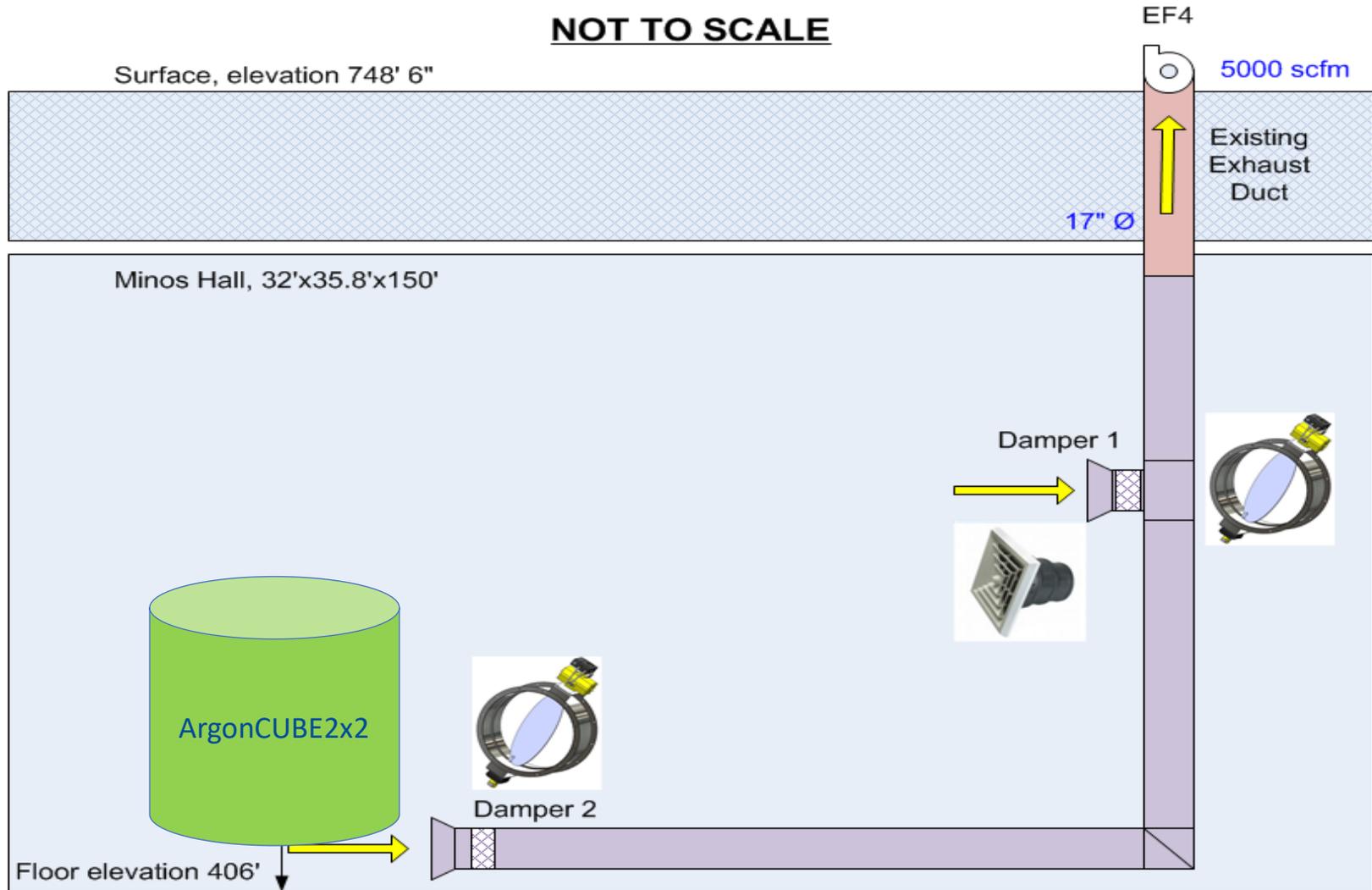








NOT TO SCALE



2x2 Mechanical Installation Task Short List

6/24/19

- Detector hall model cleanup
 - Remove Minerva detector except helium vent line
 - Remove MINOS Service except cooling water line
 - 2x2 vessel 3d model integration
- 2x2 layout sceneries
 - Minerva support rail re-configuration
 - Lower 24 downstream modules to touch floor
 - Same height for 12 upstream modules? (beamline angle?)
 - Possibility of raising 2x2 module
 - 2x2 under MINOS drip ceiling – bridge platforms crossing catwalks
 - ~~○ 2x2 with MINOS in place – need access platform~~
 - Cryogenic support platform
 - Exhaust fan duct extension layout
 - Vent pipe extension layout
- ~~• 2x2 shipping and transportation support~~

ArgonCube2x2 Design Questions

6/24/19

- Height match of 2x2 to Minerva modules
 - Minerva center:3.3m
 - ~1.2m from bottom of Minerva to floor
 - Center to be 2.1m after lowering module to touch floor
 - 2x2 TPC center:1.5m?
 - How high we can raise cryostat? $0.8\text{m}=6.5-2.7-2-1$
 - Crane to floor (6.5m) – cryostat (2.7m) – TPC (2m) – hook height (1m?)
 - Beamline angle:
- Access to top of Minerva module
 - Existing setup
 - Simple ladder to reach PMTs after lowing Minerva to the floor?
 - 12 modules upstream: 4m (h) x 4m (w) x 0.56m (depth)
 - 24 modules downstream: 4m (h) x 4m (w) x 1.1m (depth)
 - Bridge platform over two catwalks
 - Height of catwalk floor:
 - Space between two catwalks:
- Gaps needed between 2x2 and Minerva for
 - Detector access
 - Cryogenics
 - Electronics
- Minos drip ceiling coverage
 - ~~Possibility of extension~~
- ~~Minos magnetic field at upstream end~~
 - ~~How close can we put detector to Minos? 1.75m (2m)?~~
 - ~~Magnetic coil extends 1.5m(?) upstream from 1st Minos plane~~